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### Getting acquainted with.... Bowzer's Digestive System Written by: Linda Aronson, DVM

*This is the first in an occasional series on the different systems making up the Beardie's body and some of the things that can go wrong with them.*

The past three months we have looked at the various components of our beardies' diets. Now, we'd like to take you on a trip with that food as it passes through your beardie.

**At the beginning:** We have already talked about teeth (Beardie Bulletin) so let's look at the rest of the mouth. The lips may first be used to pick up food, and the tongue may be used to taste test before the real job of eating begins. The teeth are used to grab, tear and chew up food, which is mixed up by the tongue with the first of the digestive enzymes contained in the saliva. Once the food is ready, the tongue moves it to the back of the oral cavity for swallowing. (OK, I know some dogs seem to by-pass all these steps and just go for the kill and bolt down whatever they have in their mouth before anyone can try to take it from them, but I am talking about an ideal world.

The mucous membranes of the oral cavity are a common site for **tumors** - oral neoplasia is the fifth most common cancer in dogs. Not all tumors are malignant. **Viral papilloma** and **epulis** are the most common benign growths. The former start as smooth elevations, but rapidly become roughened with deep clefts and dense fronds. These usually resolve by themselves in time. They may be found in young dogs, whereas most growths appear in older animals. Epulides form in the gums near to the teeth. There are three types: fibrous, ossifying and squamous. The first two hang from stalks, do not ulcerate and don't invade the surrounding tissues. Squamous epulides do invade surrounding tissue and can lead to destruction of bone. It is often advisable to remove these growths as they can grow to a size where they get caught between the teeth when the dog bites, or be large enough to prevent him closing his mouth. There are other benign growths, but these are the most common.

The most common malignant tumors are **malignant melanomas** and **squamous cell carcinomas** (SCCs). The former are fast growing and invade the gums and bones, spreading rapidly to local lymph nodes and also to the lung. They are dome shaped and have varying pigmentation from



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black to none. While 25% are benign, all should be considered malignant until they have been evaluated. While SCCs may project out from the gums, they are usually ulcerated and erosive. They are often located inside the canine teeth. While most invade the bone and cause local damage, they rarely spread to the lung, but may invade local lymph nodes.

**Fibrosarcomas** can be found in similar locations to SCCs, although more often on the outer surface of the upper teeth from the canine back. While locally invasive they rarely spread elsewhere in the body. They are also found in young dogs, and generally recur after removal. There are other malignant oral tumors.

**Cleft lips** and **palates** are congenital malformations seen in newborn puppies, but in general these animals are euthanatized if they survive birth as the prognosis is poor. They can be surgically repaired at 6 to 8 weeks of age, but as the pups cannot nurse, risk aspiration pneumonia (caused by food going into the lungs) and have poor weight gain and stunted growth it is rarely attempted. Frequently, these puppies are also afflicted with other problems too. **Traumatic injury** of the palate, lips and cheeks is common. Puppies chewing on electrical cords or taste testing substances that are too hot or are chemically corrosive can receive serious burns. These should be assessed by a veterinarian as soon as possible. Sticks and other objects can cause serious injury too. **Oronasal fistulas** (passages between the mouth and nose) arise most often from abscesses of the tooth root or lost/extracted teeth. This can lead to infection and inflammation of the nasal cavity and/or sinuses.

**Lip-fold dermatitis** is not uncommon in beardies. Saliva runs out onto the skin of the lip and in the moist pockets bacteria grow in a mixture of food and hair; this results in redness, exudate and a bad smell often mistaken for bad breath. While surgical correction may be needed in some breeds, in Beardies, careful cleaning of the lips is usually sufficient.

**Oral ulceration** or **stomatitis** can have many causes. Of particular concern in Beardies are the autoimmune diseases pemphigus foliaceus and systemic lupus erythematosus. Other causes of ulceration can be equally serious and should always be followed up, usually with punch biopsy of the lesion.

The **tongue** can also be afflicted with congenital problems. **Bird tongue** - an incomplete or abnormally developed tongue - is usually fatal as the pups cannot nurse. Those that do survive have life-long problems eating and



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drinking. Inappropriate attachments of the **frenulum** (the mucous membrane attaching the under side of the tongue to the floor of the mouth) can be corrected by cutting the frenulum. If the tongue falls to one side, cutting the surface muscle on the other side next to the frenulum is corrective. The tongue also suffers similar **traumas** to the rest of the mouth, but is also afflicted with string and compression injuries. Dogs can manage to eat and drink quite well even if they lose the last third of their tongues. Inability to retract the tongue into the mouth, shrinking of the tongue or uncoordinated licking or lapping indicates problems with the XII th cranial nerve (hypoglossal) or in the medulla of the brain. Usually other signs of damage will be apparent.

There are four pairs of **salivary glands** – parotid, mandibular, sublingual and zygomatic. Saliva (like the secretions of the stomach, duodenum and pancreas) consists of water, electrolytes, digestive enzymes, proteins and other substances. The primary enzyme in saliva is amylase (also known as ptyalin) which splits carbohydrates into simpler molecules (disaccharides). However, food passes quickly from the mouth to the stomach, where the environment is too acidic for optimal function of the enzyme. The role of saliva therefore, is mostly to lubricate the food and help it on its way. The sight and smell or any other sensory clues stimulate the release of saliva and the other enzymatic digestive juices. Mechanical and chemical stimulation by the food itself increases production.

**Ptyalism** is the excessive secretion of saliva. In almost all cases this is a secondary condition, poisons (organophosphates, heavy metals), viruses (distemper, rabies), intraoral disease (ulcers, foreign bodies congenital malformation), neuromuscular diseases affecting swallowing, and portosystemic shunt (a congenital disease in which blood from the digestive tract by-passes the liver allowing toxins into the blood stream) can all cause ptyalism. The primary disease will be recognized in puppies at weaning, and is controllable. The opposite problem – xerostomia or **dry mouth** – is poorly understood, but usually responds to steroid treatment.

The most common disease of the salivary glands is a **mucocele**, where saliva accumulates in the tissues under the skin and sets off inflammatory reactions. These may be the result of trauma, although in most cases the glands will repair themselves. These swell and are initially painful. Dogs may be reluctant to eat. They should be differentiated from tumors, and usually removal of the affected salivary glands is the treatment of choice.



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Are you ready? Our food has been rolled up (hopefully) into a ball or bolus and now it's time to **Swallow!** This is also known as deglutition if you want to be fancy. First though, we need a little anatomy. The pharynx is a musculomembranous tube that opens from the back of the oral cavity. It also has openings from the nasal cavity, the auditory (or Eustachian) tube connecting to the middle ear, the larynx and the esophagus. Tonsils - of which the long, cylindrical palatine tonsil is the most easily identified - are lymphatic tissues that surround the pharynx and help protect against microorganisms and toxic substances. **Tonsillitis** in dogs usually accompanies **acute pharyngitis** which is usually the result of viral infection. The dog has a fever and is very painful, frequently salivates and holds the neck extended. Often the dog stops eating and drinking and must be hydrated until the pain subsides after 3 to 5 days. **Chronic pharyngitis** results in retching (independent of eating) and periods of pica (eating non food objects). The cause is unclear, but the pharyngeal tissue is red and thickened. The condition may be resolved by reducing the inflammation and feeding small amounts of soft non irritating foods.

The entrance to the larynx is guarded by the shield shaped epiglottis. At rest it stands up and allows air to flow freely from the nose or mouth into the larynx. During swallowing though it folds back to prevent food and drink entering the larynx. The esophagus is a hollow muscular tube running from the pharynx to the stomach. At rest it is collapsed, but it is capable of dramatic distension. Muscles at the top of the esophagus (upper esophageal sphincter - UES) keep the esophagus closed except during swallowing to prevent regurgitation of food from the esophagus and stomach. The sphincter is controlled by nerves carried in the IX and X cranial nerves. In dogs all the muscles of the esophagus are striated and can be consciously controlled, this is not the case in most other species. Muscles at the bottom of the esophagus form the lower esophageal sphincter (LES) to prevent stomach contents backing up into the esophagus.

Swallowing is a complex process and it is coordinated by the deglutition center in the medulla - a part of the brain stem. The base of the tongue acts like a plunger to push food balls into the pharynx. The soft palate rises and the epiglottis covers the larynx. Breathing is reflexively stopped. Muscular contraction in the pharynx pushes the food ball into the esophagus as neural input causes the UES to relax. Rhythmic (peristaltic) waves of contraction in the esophageal muscles propel the food through the esophagus. As the bolus approaches the lower end of the esophagus the LES relaxes and food enters



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the stomach. The LES then clamps shut again. Despite popular belief, gravity plays no role in swallowing in healthy animals. Once it has begun, swallowing becomes involuntary, and the process continues whether or not food or drink enters the esophagus. However, the size and nature of the bolus does determine the strength and speed of contractions. In dogs esophageal peristalsis is very fast – 75 to 100 cms/sec.

Several problems can affect the esophagus. **Megaesophagus** is a general term for enlargement of the esophagus. Some puppies are born with megaesophagus, and it appears to be a genetic trait. In some this will resolve spontaneously, but if it has not improved by 6 months of age, the prognosis is very poor. Fortunately, it does not seem to be a problem in Beardies. Acquired megaesophagus is characterized by a large, dilated, flabby esophagus caused by a loss of peristaltic contractions. It occurs spontaneously in dogs usually between the ages of 7 and 15 years. The UES and LES function normally, and while the cause has not been determined, it appears to be due to failure of nerve signals rather than muscle function.

Megaesophagus can occur, less often, secondary to a number of conditions - the most common is **myasthenia gravis**. This is an autoimmune disease in which the body makes antibodies against the muscle receptors which receive signals from the nerves telling them to contract. Striated muscle throughout the body is affected. Increasingly stronger nerve signals are needed to cause muscle contraction. Other causes include foreign bodies, tumors, infections, toxins, other autoimmune and endocrine diseases and basically any disease that can affect nerve and/or muscle function. The most common sign is regurgitation. Treatment is directed at treating the underlying cause, and where this is possible prognosis is good. For congenital and idiopathic megaesophagus and conditions that are not responsive to treatment prognosis is poor. The majority of dogs will get aspiration pneumonia, due to food ending up in the lungs either during feeding or regurgitation. Repeated pneumonias become more severe and difficult to treat. The other major problem is maintaining adequate nutrition in the face of regurgitation. Feeding frequent, small high calorie meals with the dog in an upright position so that gravity can help get food into the stomach. Meat balls seem to be the best tolerated foods. Some animals are maintained by feeding through stomach tubes.

One cause of megaesophagus is **dysautonomia**. This is the result of failure of the autonomic (reflex) nervous system. It is usually seen in young dogs



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and has a rapid onset. The heart may also be slow, and mucous membranes and eyes dry. The prognosis is poor.

**Esophagitis** – inflammation of the esophageal walls - can range from mild to severe ulceration and erosion of wall. It is usually the result of eating or drinking corrosive substances. Foreign bodies or food retention, as seen in megaesophagus or something getting stuck in the throat – as often happens with humans taking pills – can cause secondary inflammation. Reflux of fluids from the stomach is another cause. If your dog swallows something caustic, do not induce vomiting. If you know the nature of what he swallowed you can try to neutralize it – dilute vinegar for alkaline substances, milk of magnesia for acids, and egg whites or activated charcoal for other toxins. Call Animal Poison Hotline 888-232-8870 or a similar service for specific information. Resting the esophagus by not feeding and giving minimal fluids is usually corrective in mild cases, in more severe cases, placing a feeding tube may be necessary. Anesthesia, drugs, obesity, hiatal hernias and persistent vomiting can all cause gastric reflux. Again treating the underlying cause is important. The esophagus passes through a hole or “hiatus” in the diaphragm to enter the abdominal cavity. A **hiatal hernia** is the result of the abdominal part of the esophagus and/or part of the stomach poking back through the hiatus. The stomach may also fold back into the esophagus. Treatment may be medical or surgical depending on the severity and cause.

**Esophageal foreign bodies** are common in dogs. However, in many cases swallowed objects do pass through the esophagus due to its capacity for expansion. Pointy and sharp objects are most likely to get stuck and cause partial or complete obstruction. Some dogs seem particularly prone, usually they are young. In general, prompt removal is advisable, as the longer the object remains the more damage it can do. If possible endoscopic removal is preferred, as esophageal surgery is not well tolerated. After removal the animal is fasted for 24 to 48 hours to let the esophagus recover. Deep damage within the esophageal wall can result in **strictures**, which can cause partial esophageal blockage. Mechanical dilation with special balloons is the treatment of choice, and surgery carries a poor prognosis. Congenital malformations of the blood vessels to and from the heart can entrap the esophagus and cause obstruction – **vascular ring anomaly** – these must be corrected surgically.

**Esophageal cancer** is rare, and most often originates elsewhere.



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The **stomach** lies just behind the diaphragm on the left of the dog and just behind the liver. As we mentioned before, the sensory anticipation of food, as well as finally tasting it, causes the secretion of the stomach's digestive juices. These include hydrochloric acid and pepsinogen, which the acid converts to the active form pepsin. This starts the digestion of meat proteins – but has little effect on proteins of vegetable origin. The cells lining the stomach are protected from digesting themselves by the secretion of bicarbonate, which is kept near the surface by a gel like mucus that is also protective. The stomach also releases an intrinsic factor which binds Vitamin B12 for later absorption. The stomach walls propel food by peristalsis. The rate at which the stomach empties depends on the difference in pressure between the stomach and the first part of the small intestine – the duodenum. The more fluid there is in a meal, the faster it will pass through the stomach.

Problems with the stomach are usually related to vomiting (which may include blood), melena (black, tarry feces – actually digested blood), loss of appetite, distension of the abdomen and/or abdominal pain. Vomiting may also be caused by intestinal – usually duodenal – disease or metabolic disorders (kidney, liver or adrenal failure, elevated blood calcium, diabetes or pancreatitis). Vomiting is a coordinated reflex, the control center being in the medulla in the brain stem. Blood in the vomit usually looks more like coffee grounds than red blood, and indicates ulceration of the stomach wall. Melena indicates upper gastrointestinal bleeding, although activated charcoal or bismuth can give stools the same appearance. Anorexia may have many causes, but quite often animals can feel too nauseous to eat even though they aren't actually vomiting. The abdomen can be distended by fluid, gas or tissue, but the first major differential diagnosis is gastric dilatation/volvulus (GDV) – bloat – especially if the dog is retching without throwing up. Abdominal pain is rarely caused by gastric diseases other than ulceration. Dogs “splint” or tense their abdomens when they are painful – especially if you go to examine them. They also tend to bow or “pray,” while this can be due to pain anywhere in the abdomen, I usually associate this most often with pancreatic pain.

The stomach can be examined using X-rays – plain or contrast (with barium), endoscopy, ultrasound, nuclear scintigraphy and/or surgery. Complete blood counts, biochemistry profiles and urinalysis (mostly looking at pH – acidity) as well as examination of gastric fluid may also be useful.



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**Acute gastritis** is the most common cause of acute vomiting other than motion sickness. Most animals aren't seriously ill. Causes include eating non food items or poisons (chemicals, plants, mushrooms, drugs); spoiled food; dietary intolerance/allergy; viral, bacterial or parasitic illnesses; or organ failure. Most patients recover in one to five days. In some cases (very young, small, seriously ill or dehydrated) fluid therapy, electrolytes and medicine to stop the vomiting may be in order. In general, withholding food for 24 to 36 hours after the animal stops vomiting is wise. Treating the underlying cause of the vomiting, if it can be found, is obviously in order. Chronic gastritis is usually related to inflammatory bowel disease, and we will consider this when we reach the intestines.

**Gastric ulcers/erosion (GUE)** is a defect of the lining of the stomach which usually penetrates into the muscle layer. In dogs the most common cause of GUE is administering ulcerogenic drugs, most notably the nonsteroidal antiinflammatories (NSAIDs) especially those that don't exhibit COX-2 specificity – like aspirin - and steroids – like prednisone and dexamethasone. Stress – psychological and physiological is another cause of GUE. Mast cell tumors contain histamine and this causes increased gastric acid secretion. Another type of tumor is the gastrinoma – usually found in the pancreas. These produce gastrin which causes gastric acid release too. Severe liver and kidney disease as well as foreign bodies can also produce GUE. Contrast X-rays are usually diagnostic. Obviously the cause of the ulcers should be addressed, but unless the dog risks bleeding to death, most GUE can be treated medically with antacids/anti-histamine products. Omeprazole appears to be the most effective drug.

**Bilious vomiting syndrome** or reflux gastritis is the \$10 terms for when a healthy dog throws up a bit of bile in the morning. The exact cause is unknown, but it seems to be a response to an empty stomach causing fluid to back up into the stomach from the duodenum. Giving the dog a large biscuit bone at night is usually curative.

The outlet of the stomach into the duodenum is called the pylorus. If it is obstructed food backs up and the dog usually vomits. Obstruction can be by foreign objects, masses growing in or close to the pyloric sphincter, compression by other abdominal organs, or malposition/twisting. Whether or not **foreign objects** should be removed either with an endoscope or surgically depends on the nature of the object as well as whether or not it is able to physically pass through the digestive system without causing a



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blockage. Sharp objects might perforate the g/i walls, however, there may be too many fragments – for example broken glass - to ensure removing them all. One strategy is to feed the dog cotton balls soaked in moist food or milk or Metamucil to enable the dog to pass them safely. For a Beardie, three or four handfuls of cotton balls would be appropriate. Linear foreign objects – string, tinsel, fishing line, etc. – also present a problem. Once these enter the duodenum they are dangerous either to remove or allow to pass through, as they can cause the intestines to pleat up like an accordion and cause countless small tears in the intestinal walls – especially if one end remains caught, or you attempt to remove them by pulling on one end.

Fortunately, **gastric dilatation/volvulus** rarely happens in Beardies. It is associated with young, deep-chested, large and giant breeds of dog. It is also associated with feeding kibble and feeding one meal a day vs. multiple meals. The stomach dilates with air, whether or not fluid and food are present. The stomach may stay in place (gastric dilatation) or twist around an axis from the gastro-esophageal antrum and the pylorus – volvulus. Usually the pylorus passes under the body of the stomach and ends up above the antrum. GDV is life threatening as blood flow to the stomach and other organs is interrupted. Time is of the essence, and even so it is often fatal. Dogs must be treated for shock, and the distention relieved. Surgery may be necessary, and if so, the stomach is usually fixed in place by one of several techniques to prevent recurrence. This isn't always possible.

Gastric tumors may obstruct the normal progression of food through the stomach even if they are not malignant. Polyps are quite common and unless they do block passage of food they usually go unnoticed. Gastric leiomyomas are seen in older dogs, and usually occur near the gastric inlet. They are also benign unless they cause obstruction. Most malignant tumors are primary and rarely spread elsewhere in the body. Adenocarcinomas are the most common and these may be genetic in nature. Lymphosarcomas are uncommon, but may involve the intestine as well as the stomach.

Next time we will continue our journey into the intestines and look at the associated digestive organs, the pancreas and liver.